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ABSTRACT

A two-tiered model of group influences on individual choice behavior is developed and evidence relevant to the model is reviewed in this paper. The model consists of two parts: a model of individual choice, and models of group influence on components of the individual choice model. The model of individual choice is based on the elimination-by-aspects choice model of Tversky. This choice model suggests two sources of influence that groups might have on individuals: messages sent by other group members might change the value an individual attaches to a given choice criterion; or, messages sent by other group members might change the individual's estimate of the probability that a given alternative possesses a certain attribute. Models of both sources of group influence are developed, and implications and testing of the model are discussed. (Author)

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A MODEL OF GROUP INFLUENCES ON
INDIVIDUAL BEHAVIORAL CHOICE

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Investigating the effects of group discussion was a primary emphasis in early speech communication research (Mortensen, 1970). Although interest in this problem area has dropped off in recent years, the study of group discussion promises important theoretical and practical results for at least three reasons. First, there is abundant evidence that the groups a person belongs to play a major role in determining his or her beliefs, attitudes, and behaviors (Shaw, 1976; Keisler and Keisler, 1970; Newcomb, 1958). Group discussions serve as a key means of socialization and social influence. Second, group discussion is an important aspect of most group decision-making situations. Since group modes of decision-making are becoming increasingly prevalent in business and government, the study of group discussion and its effect on decisions is especially important for pragmatic reasons. Finally, study of the effects of group discussions can be easily tied to interaction analysis of groups to yield interesting theoretical and practical insights. Such syntheses increase the range of phenomena which a unified theory of group processes would cover and deepen our understanding of group processes. Since, as Gouran (1972) has suggested, groups making choices or decisions (including such varied groups as planning boards and a set of friends trying to decide what to do on a Saturday night) provide a natural focus for communication researchers in the study of groups, this paper will focus on decision-making groups.

In recent years a great deal of work germane to group discussion has been inspired by the "risky shift" phenomenon (Stoner, 1961; Wallach, Kogan, and Bem, 1962). More recently, it has been found that the shift due to group discussion applies not only to the risk dimension, but to other dimensions involved in choice as well (Pruitt, 1971 a and b). Myers and Lamm (1976), in an impressive review, have summarized evidence that the shift phenomenon is general, holding for attitudes, jury decisions, ethical decisions, judgments, person perception and negotiations. It seems likely that risky and cautious shifts, as well as other group "polarization" phenomena, can be subsumed under a single group choice shift

model. It is the purpose of this paper to provide such a model.

The research generated by the group shift phenomenon (which will be discussed below) is especially interesting because it takes as a central focus choice from among a number of alternatives. This is significant because, while researchers are tempted to focus on single-task or single-alternative experimental designs for reasons of convenience, in most "real-life" situations a decision-making group must consider several alternatives or a number of dimensions in carrying out its functions. An explication of how group members choose among alternatives is necessary if we are to understand group decision making. Davis' (1973) theory of social decision schemes takes one approach to this problem by suggesting a model in which individual preferences are mapped onto the final group choice on the basis of a priori social influence patterns. The model developed in this paper suggests an alternative approach in which messages exchanged in group discussions change individual members' preferences and choice criteria, causing a convergence of member preferences about the chosen alternative.

Theories of group influence on choice also have important implications for another problem area which has recently enjoyed prominence in communication research--the attitude-behavior consistency question. Although very few empirical studies in the attitude-behavior area have taken behavioral choice into account, at least at the theoretical level the common assumption is that behaviors are selected from a set of possible behaviors, all of which "compete" in the minds of individuals (Fishbein, 1967; 1973; Schuman and Johnson, 1976; Hewes, 1975). Moreover, most models of the attitude-behavior relationship include social influence as a major factor governing behavioral choice (Fishbein, 1967; Seibold, 1975). The nature of the social influence process, however, is generally left unspecified in such models. In most work on the attitude-behavior problem the influence of social factors on behavioral choice has been ascertained by a global question concerning expectations of significant others (notable exceptions are Azjen, 1971 and Sanger-

Nocks, 1976). The model developed below suggests a specific environment and mechanism for social influence. In addition, the model incorporates influences of others' expectations on individuals' attitudes. Many models of the attitude-behavior relationship have assumed that attitude and normative influence exert independent causal effects on behavior or behavioral intention (Fishbein, 1973; Schwartz and Tessler, 1972; Seibold, 1975). While this may indeed be the case for cross-sectional data, the influence over time of reference group attitudes on individual attitudes is well-documented (Newcomb, 1959; Brannon et al., 1973). In a review of six studies which included both reference group attitude and individual attitude as variables, Schuman and Johnson (1976) reported that in all six studies there was a sizeable correlation between the two, although they both had independent effects on behavior. The group discussion literature suggests several mechanisms by which reference groups could influence individuals' attitudes, including providing models and generating pressures for conformity with the majority. The model developed in this paper allows for both: (1) direct effects of others' expectations and individual's attitudes on behavioral choice and (2) the effects of others' expectations and opinions on individual's attitudes.

The previous discussion suggests that the model of a group's influence on the behavioral choices of its members can logically be divided into two distinct components-- a model of individual choice and a model of group influence on inputs to the individual choice model. Such a division not only allows us to simplify the model considerably, but is also consistent with recent findings in information processing research. In the next section we will outline the first component, a model of individual behavioral choice and review the evidence for that model. The choice model assumes that all individuals reach decisions by the same process, and that differences in decisions among individuals are primarily a result of differences in inputs (or differences in perception of inputs). In the third section we will develop the second component of the model-- a model of group influence on inputs to the individual choice process. Linking the two components results in an information-processing model of group

influence on individual choice which can explain group shift phenomena and cast light on the message-attitude-behavior relationship. Extensions and implications of the basic model will be considered in the final section.

THE CHOICE MODEL: ELIMINATION BY ASPECTS

Fishbein (1967) also recognized that behaviors are chosen from a set of alternatives and justifies his model for predicting behavioral intentions by noting the similarity between his measure of attitude and a multi-attribute subjective expected utility (SEU) model of behavior. Presumably the behavior with the most favorable attitude would be the one chosen, ceteris paribus. Burnstein et al. (1971) and Vinokur (1971) have explained shifts in group risk preferences in terms of group-induced changes in the utilities assigned by group members to the outcomes associated with the available alternatives. In both cases the preferred choice alternative was assumed to be the one with the highest expected utility. However, the utility theory view of behavioral choice has several problems. An assumption of most utility models is that all the relevant alternatives are independent of one another. This requires (1) that a utility function be found that assigns values to all alternatives and (2) that the probability of choosing a given alternative is in turn a monotonic function of the values assigned to the respective alternatives (the assumption of simple scalability; Tversky, 1972). An example of such a choice model is provided by Luce (1959), where

$$P(x,A) = \frac{u(x)}{\sum_{y \in A} u(y)} .$$

Here $P(x,A)$ is the probability of choosing x from the set of alternatives A which includes x and $u(x)$ is the value of x . In this model the more valuable x is, the more probable is its choice. This approach requires two problematic assumptions. First, it requires us to assume that individuals can assign values to a whole set of alternatives via a multiattribute utility function and keep these alternative values in mind while making a choice. Physiological limitations on human information processing capabilities would make this impossible for even

small sets of alternatives and a small number of attributes (Simon and Newell, 1971). Even if we relax the assumption that scale values must be assigned to alternatives and allow ordinal rankings, the task is still more complex than our limited capabilities allow. Human beings process information sequentially and can keep only a few bits of information in mind at a time. Assignment of values or ranking of a complete set of more than a few alternatives (plus taking a number of attributes into account when making value or rank assignments) is such a complex task that it is unrealistic to assume that it occurs every time we choose a behavior.

The approach outlined above also requires a second assumption; the implications of which are even more unacceptable. As Tversky (1972) demonstrates, the scalability assumption implies that the choice probabilities of alternative x and alternative y will be ordered in the same way regardless of the subset of alternatives they are contained in. This is equivalent to saying that the context (i.e., the set of alternatives) has no effect on whether x or y is preferred. However, this requirement leads to some obviously incorrect inferences. Assume x is preferred to y in a given situation (e.g., $P(x; \{x, y\}) = \frac{2}{3}$; $P(y; \{x, y\}) = \frac{1}{3}$). Let us add to the set of possible alternatives two more (a and b) which are extremely similar to x , and assume the individual to be indifferent among a , b , and x . Since there is equal probability of choosing a , b , and x we would expect the total probability of choosing x from the set x, y to be split among the three behaviors so that $P(x; \{x, y, a, b\}) = \frac{2}{9}$, $P(a; x, y, a, b) = \frac{2}{9}$, $P(b; \{x, y, a, b\}) = \frac{2}{9}$, and $P(y; \{x, y, a, b\}) = \frac{1}{3}$. Note that for this subset $P(y) > P(x)$, a finding that goes against the scalability assumption, which requires that $P(x)$ should always be preferred to $P(y)$ once the alternatives have been ordered. Intuitively it seems that the nature of the set of alternatives does make a difference in choice probabilities by

influencing the comparability of alternatives. Much empirical support for this contention has been found in the case of multiattribute utility models (Tversky, 1972; Tversky & Russo, 1969; Becker, DeBroot, & Marshak, 1963; Coombs, 1958).

Tversky (1972) has developed a theory of choice that allows us to circumvent the problems noted above. He describes it as follows:

The present development describes choice as a covert sequential elimination process. Suppose that each alternative consists of a set of aspects of characteristics, and that at every stage of the process, an aspect is selected (from those included in the available alternatives) with probability that is proportional to its weight. The selection of an aspect eliminates all the alternatives that do not include the selected aspect, and the process continues until a single alternative remains. If a selected aspect is included in all the available alternatives, no alternative is eliminated and a new aspect is selected. Consequently, aspects that are common to all the alternatives under consideration do not affect choice probabilities. Since the present theory describes choice as an elimination process governed by successive selection of aspects, it is called the elimination-by-aspects (EBA) model.

An example of the choice process implied by the EBA model might go as follows:

Mr. Jones wants to buy a house and knows of six alternatives. He only wants to spend \$30,000, and two of the possibilities cost more than that, so they are ruled out. He wants the house to have three bedrooms so that one can be used as a guestroom. Only two of the remaining four have three bedrooms, so now he is down to two alternatives. Another thing he would like is for the house to be close to a school for his son. Only one of the two is close to a school, so he picks that one as his preferred alternative.

Since the model posits a sequential process, it is within human information processing capabilities: in the EBA framework there is no need for subjects to completely order alternatives in terms of utilities. Further, alternatives need no longer be regarded as independent. The subset of alternatives considered does effect the probability of choosing a given alternative, since the aspects

used to distinguish among alternatives will be different for each subset. The model calls to mind a tree diagram where each node is a question, "Does the alternative possess attribute ___?". By passing through enough nodes and consistently taking the "yes" path, one eventually reaches a single alternative (which is then chosen). Tversky's formulation is similar to the lexicographic model of choice, in which the order in which attributes are considered in screening possible models is determined by the relative values or importance of the attributes (Johnson & Huber, 1976). Conceived as a series of binary choices, the decision model is not very amenable to mathematical expression. However, Tversky has developed an expression which allows computations of probabilities of choosing a given alternative, independent of process considerations. First, however, some notation should be introduced.

Let $A = \{x, y, \dots, z\}$ be the set of k alternative behaviors. $P(x; A)$ is the probability of choosing alternative x from the set of alternatives A . Let α_i and β_i be aspects or attributes of the behaviors. A' is the set of all aspects contained in the members of A . The x' represents the set of aspects belonging to alternative x . Let $u(\alpha_i)$ be the value of aspect α_i . Finally, let A^0 be the set of aspects belonging to all alternatives in A and let A_{α_i} denote those alternatives in A which include α_i , i.e., $A_{\alpha_i} = \{x | x \in A \text{ \& } \alpha_i \in x'\}$

First, consider a two alternative set Q , where $Q \subset A$, such that $Q = \{x, y\}$ and where $x' = \{\alpha_1, \alpha_2, \beta_1, \beta_2\}$ and $y' = \{\alpha_1, \beta_1, \alpha_3, \beta_3\}$. For this instance

$$P(x; Q) = \frac{u(\alpha_2) + u(\beta_2)}{u(\alpha_2) + u(\beta_2) + u(\alpha_3) + u(\beta_3)}$$

$$P(y; Q) = \frac{u(\alpha_3) + u(\beta_3)}{u(\alpha_2) + u(\beta_2) + u(\alpha_3) + u(\beta_3)}$$

Note that α_1 and β_1 are not considered in this instance, since they are shared by both alternatives and thus play no role in the elimination process. The probability of selecting a given alternative is dependent on how large the values of the aspects unique to that alternative are. More generally, the

EBA choice model can be expressed as:

$$P(x; A) = \frac{\sum_{\alpha_i \in x' - A^0} u(\alpha_i) P(x, A_{\alpha_i})}{\sum_{\beta_i \in A' - A^0} u(\beta_i)}$$

The $P(x, A_{\alpha_i})$ in term is a composite probability of selecting x from the set of alternatives that also contain attribute α_i . It serves to "split" the utility or value of attribute α_i among the alternatives that contain α_i according to their probability of being chosen from among all alternatives that contain α_i .

GROUP INFLUENCES ON CHOICE

Many explanations have been advanced for group influences on individuals' choices. Reviews of research in the group shift area have ruled out a number of these explanations, including the diffusion of responsibility, familiarization with topic, and most variants of leadership theory (see Pruitt, 1971a and 1971 and Myers & Lamm, 1976 for detailed consideration of these explanations and the available evidence). Recent work has provided a good deal of support for two explanations: (a) interpersonal comparison (value theory) and (b) informational influence. The first explanation explains shift in terms of social motivation. It posits that individuals desire to perceive and present themselves favorably in social situations. Thus, when the individual is exposed to others' positions, he (she) may either readjust his (her) response in order to maintain a socially desirable image or actually change his (her) position because some model other has validated a position the individual is attracted to but afraid to express. The information influence explanation suggests that the preponderance of arguments that occur during group discussion favor the alternative that the majority initially prefers. The messages generated evoke a response change in group members resulting from new cognitive learning. Several possible

explanations for differential message impacts have been put forward, including the relative novelty of the various arguments, more extreme group members being seen as more competent or able, and more extreme group members having higher levels of confidence.

While both explanations seem plausible and have received some support, it is obvious that they are not mutually exclusive. The interpersonal comparison explanation proposes no mechanism to explain the process of group shift and the most plausible mechanism involves group members sending messages or "discretionary stimuli" to one another (Hackman, 1976). *Thus it can be reduced to message impact model.* It is important to note at this point that the phenomenon of group polarization does not apply to individual group members. While the group mean does move toward the extreme end of a given scale, individual group members converge as a result of discussion (McCawley, 1970; Ferguson & Vidmar, 1971). This implies that subjects with extreme attitudes are moderating their views in light of messages sent by less extreme subjects, while those that are less extreme are becoming more extreme due to messages sent by extreme members. The net result is convergence of member choices and a slight polarization of the group mean.

In view of the plausibility of the message influence hypothesis a model for group influences on choice will be proposed. Given the choice model outlined above, there seem to be two ways in which messages could alter choice probabilities. First, a message could raise or lower the value attached to a given attribute or aspect, i.e., change group members' attitudes toward the aspect. Second, a message could make a certain attribute particularly salient and prove or disprove the existence of a given aspect in a given alternative, i.e., *change group members' choice criteria.* Findings provided by Burnstein et al. (1971) and Vinokur (1971) suggest that the first type of message would occur considerably more often in group discussion than the second. Nonetheless, both types of message effects will be considered in turn.

The message effect models developed here rest on several assumptions, which will now be discussed:

(1) Messages from other group members are the only external source of change in attitudes or existence beliefs. As noted above, external information obtained through messages sent by other group members is required to trigger whatever internal processes mediate changes in individual preferences. If the internal process involves social comparison, the individual must receive information about others. If the internal process involves persuasion, messages are a necessary prerequisite.

(2) Change in the value of an attribute or in belief about its probability of existence is a positive function of the discrepancy between the valence of the message and the valence of the receiver's attitude or belief. This assumption is an extension of the linear discrepancy hypothesis which has received a large amount of support from research on attitude change (Hovland and Pritzkev, 1957; Bochner and Insko, 1966; Insko, 1967). Support for this assumption can also be found in the group discussion literature. In studies on choice shifts Myers and Bishop (1971) found a correlation of .37 between the proportion of arguments favoring the shift direction supported by the majority and the magnitude of shift in that direction, while Baron et al. (1971) showed that the direction of arguments presented in a group determined the extent and direction of group shift. A number of studies have shown a very high correlation (around .9) between direction of discussion arguments and direction of group shift obtained (Myers & Lamm, 1976, p. 616). Although these experiments involve group rather than individual shifts, as noted above mean group shift is usually produced by aggregation of individual shifts. Although individuals in groups converge, the group mean polarizes in the direction favored by most group members because more positive messages are sent about the favored

direction than negative or neutral ones (Silverthorne, 1971; Nordhoy, 1972). Discrepancy theory would predict this effect, since it implies greater change given more extreme (and larger numbers of) messages and also convergence of attitudes among individuals in closed systems (Hunter, 1975).

(3) Messages are only integrated into the individuals' cognitive system when the individual thinks about the attribute or belief the message pertains to. Greenwald (1968) observed that passive learning of message contents was not enough to induce attitude change. Subjects also had to actively rehearse or reformulate messages for the attitude change induced by the message to become internalized. Subjects must, in other words, be actively engaged in thinking about the attitude or belief in question for received messages to be integrated into the existing cognitive system. Poole and Hunter (1976) demonstrated that this was a reasonable assumption for internally-induced attitude change as well as for attitude change due to external messages. Myers and Lamm (1976) use this assumption to account for the reduced shift observed in individuals who passively listen to group discussion, as opposed to those who actively participate. They argue that participation in discussions and debates causes individuals to actively rehearse arguments and counterarguments to a greater extent than passive listening. Work on the differential effects of group discussions and lecture on learning (Lewin, 1947; McKenchie, 1968) supports this conclusion. In a choice situation similar to the one outlined above individuals would think through the attributes and their relationships to the set of alternatives prior to making choices. Thus messages should be integrated into the existing system of attitudes and beliefs when group choices are made. This implies that the time unit for message effects should be the interval between individual choices. Hence, the model does not operate in terms of metric time, but rather in terms of psychological time, with transitions determined by the frequency of group decisions.

(4) Messages will have an impact on attitudes and beliefs proportional to the prestige or status accorded the sender by the receiver. This assumption draws on the vast amount of work done on source credibility in speech-communication. Several of the theories of group shifts incorporate assumptions about how group members attain prestige. Burnstein et al. (1974) and Jellison and Riskind (1970) present evidence that people who adopt extreme choices are presumed to possess more cogent arguments and more ability than those who adopt less extreme positions. Value theory (Pruitt, 1971a) suggests that individuals who present arguments in line with an individual's unspoken values in a choice situation are taken as models by the individual, who then changes his (her) position to be more in line with his (her) "actual" values and those of his (her) model. Davis (1973) has enumerated a number of decision schemes which presumably influence the manner in which information is integrated by individuals as they move toward a decision. His hierarchical and egalitarian models suggest possible patterns of message effects.

For change in the attitude or value associated with a given attribute α_i , the four assumptions imply the following equation:

$$\Delta u(\alpha_i) = w [M(\alpha_i) - u(\alpha_i)] \quad (2)$$

where $M(\alpha_i)$ is the value of messages received concerning the attribute in a given time period and w is a message effect weight ($0 \leq w \leq 1$). The change equation (2) is equivalent to the following state equation:

$$u(\alpha_i)_{t+1} = (1-w)u(\alpha_i)_t + wM(\alpha_i)$$

The parameter w determines how great an effect a message will have on the individual's attitude. The larger w is the more responsive the individual is to outside influence. Thus the parameter w can be directly related to the individual's level of interpersonal orientation as it is discussed by Rubin and Brown (1976). Persons with high interpersonal orientation would be very responsive to

other people in the group situation and would thus be expected to be influenced to a relatively great extent by others, while those with low interpersonal orientation would be expected to hold to their own opinions rather strongly. Alternatively, the parameter w could be related to the subject's persuasibility,

The composite message value $M(\alpha_i)$ received by an individual when s other people speak is given by the equation:

$$M(\alpha_i) = \frac{\sum_{j=1}^s v_j m_j(\alpha_i)}{\sum_{j=1}^s v_j} \quad (3)$$

where $m_j(\alpha_i)$ is the value of the message(s) sent by the j th person in the group about attribute α_i during the time period in question². The weight v_j is a status weight that determines the relative contributions of the other group members to the overall informational impact on the individual. This message value model is similar to Anderson's (1971) information integration model and makes the assumption that messages are only integrated into the individual's cognitive system immediately prior to choice-making as the individual thinks through the merits of various choices (assumption 3 above).³ It differs from Anderson's usual model in that the v_i can be specified according to various influence assumptions we might want to make (this will be ~~done~~^{considered} in the next section). Equations (2) and (3) make up the model of group influence on values associated with attributes.

Independent of the values associated with a given attribute, messages from other group members may also influence whether an attribute is associated with a given alternative. Since association of an attribute with an alternative is a binary (0, 1) variable in the choice model under consideration, the change equation that determines probabilities of association must be mapped onto binary values. If $g_x(\alpha_i)$ is the association value of the attribute α_i with alternative x [$g_x(\alpha_i)$ being restricted to the values 0 and 1], then:

$$\Delta g_x(\alpha_i) = \begin{cases} +1 & \text{if } [N_x(\alpha_i) - g_x(\alpha_i)] \geq \mu \\ 0 & \text{if } -\mu < [N_x(\alpha_i) - g_x(\alpha_i)] < \mu \\ -1 & \text{if } [N_x(\alpha_i) - g_x(\alpha_i)] \leq -\mu \end{cases} \quad (4)$$

where $N_x(\alpha_i)$ is the value of message received concerning the probability of attribute α_i being associated with alternative x and μ is some cutoff point or tolerance level that is related to how much effect others' messages will have on the individual's beliefs ($0 \leq \mu \leq 1$). As such μ may be regarded as inversely related to interpersonal orientation (and thus inversely related to w). The higher μ is, the less "influencable" an individual's beliefs are.

The composite message value $N_x(\alpha_i)$ received by a person when s other people speak is given by the equation:

$$N_x(\alpha_i) = \frac{\sum_{j=1}^s v_j n_{xj}(\alpha_i)}{\sum_{j=1}^s v_j} \quad (5)$$

where $N_{xj}(\alpha_i)$ is the value of the message(s) sent by the j th person in the group during the time period in question, relating the probability that attribute α_i is associated with alternative x . The weight v_j is the same status weight discussed above. Again, message impact on belief concerning whether an attribute is associated with a given alternative or not occurs only prior to choicemaking, as the individual thinks through the merits of various choices. From equations (4) and (5), a vector of association weights ($0's$ and $1's$) can be derived that allows assignment of attributes to choices in the choice model outlined above.

The two sets of equations developed here compose the model of group influence on choice. As noted in the introduction, both message effect models allow for immediate independent influence of an individual's attitudes and of social factors (through others' messages) on behavioral choice. In addition, since message effects are incorporated into the individual's attitudes and

beliefs over time $u(x)$ is dependent on the messages received at time t ,
 $t+1$
 time $t-1, \dots$ time 0, the model allows for the effect of social factors on an
 individual's attitude.

DISCUSSION AND IMPLICATIONS

In the preceding two sections a two-tiered model of group influence on individual behavioral choice process based on Tversky's elimination-by-aspects model was developed. This choice model suggested two sources of influence that group discussions might have on individuals: (1) messages sent by other group members might change the value an individual attached to a given attribute (choice criterion); or (2) messages sent by other group members might change the individual's estimate of the probability that a given alternative possessed a certain attribute. In the preceding section, message influence models for both sources of choice shift were developed. In this section several implications of the model will be considered.

(1) The vector of influence or status weights ($\tilde{V} = [v_1, v_2, \dots, v_r]$ for an r -person group) will reflect the pattern of group influence and the differential credibility of group members. In a group where all members were equally influential $\tilde{V}$ would be a vector of 1's, whereas in a group where one member was dominant, the entry for the dominant member would be large and those for the other members correspondingly smaller. If we have reliable data and if the model does in fact hold, we might impose different a priori theoretical values on the elements of $\tilde{V}$ and determine how well the model fit for our hypothesized values. This would allow us to determine which influence process is in fact operating in the group discussion. The many theoretical positions current in group decision-making literature suggest a number of hypothetical $\tilde{V}$ vectors which could be compared for predictive accuracy. For example, the egalitarian scheme shown to hold for many problem-solving tasks (Clinton and Fink, 1962; Davis and Restle, 1963) could be incorporated into the model if all elements of $\tilde{V}$ were set to 1. A hierarchical scheme could be portrayed by setting some of the elements of $\tilde{V}$ to 1 and others to 0 or rank ordering the

elements in line with hypothesized formal status. If we specified two specific V vectors for two subgroups within a group and set $v_i = 1$ for other members of the same subgroup and 0 for members of the other subgroup, we could portray the division of the group into two opposed and hostile cliques. Alternatively, the v_i might be conceptualized as functions of some variable relevant to the group situation. If v_i were directly proportional to the extremity of the person's initial position, we would be portraying the notion of Burnstein et al. (1974) that more extreme members are seen as more competent and hence have higher credibility.

The $\bar{V}$ discussed in the preceeding paragraph are, in essence, influence schemes. The present model differs from Davis' social decision scheme model in two respects. First, Davis' model is couched at the group level, whereas the present model deals with individuals in group environments. Second, Davis' model describes influence processes from the "outside", as a mapping of individual preferences onto a group decision by means of various "schemes", vectors which summarize group processes into a single operator. He is interested in the product of the group decision process and essentially ignores changes in individual preferences during discussion. The present model, on the other hand, suggests a mechanism of influence whereby individuals change their choice preferences as a result of group discussion. It thus suggest a process by which Davis' mapping might occur. Davis' model deals with group processes by positing a function that allows us to move from initial preferences to final product without considering intermediate states. The present model tracks the process of choice shift through incremental message effects on the individual preferences, which converge gradually about a common preference.

(2) Although the model developed thus far only deals with individual shifts, it also makes possible modelling convergence to group consensus,

where all members of the group are in agreement. Under certain restrictive assumptions it would be possible to "hook together" two or more individual models. If we assume that in a given time period, each member of the group sends messages to the other members that is equivalent to his or her attitudes and beliefs at the beginning of the time period (in other words, if we assume complete veracity and disclosure), we have stabilized message inputs enough to link up the system (see Cappella, 1974; Taylor, 1968). If, in addition, at several points before making a final decision, group members take implicit or explicit "straw votes," their attitudes and beliefs would be expected to converge at some equilibrium value if discussion went on long enough. For a two person group the system of attitude equations would be:

$$\Delta x = \omega(y - x)$$

$$\Delta y = \omega(x - y)$$

if x is the first person's value for a given attribute and if y is the second person's value. This gives the state equations

$$x_2 = \omega y_1 + (1 - \omega)x_1$$

$$y_2 = \omega x_1 + (1 - \omega)y_1$$

These equations may be solved (see appendix for the solution) to yield:

$$x_n = \frac{x_1 - x_0}{2\omega} - \frac{x_1 - x_0}{2\omega} (1 - 2\omega)^n$$

$$y_n = \frac{y_1 - y_0}{2\omega} - \frac{y_1 - y_0}{2\omega} (1 - 2\omega)^n$$

the solutions to time u in terms of the first two values of x and y . Taking the limits of these equations we get the equilibrium values x_n^* and y_n^* :

$$x_n^* = \frac{x_1 - x_0}{2\omega} = \left| \frac{y_0 - x_0}{2} \right|$$

$$y_n^* = \frac{y_1 - y_0}{2\omega} = \left| \frac{x_0 - y_0}{2} \right|, \quad \therefore x_n^* = y_n^*$$

In a similar way we could solve three or more person groups and derive equilibrium values. (However the equations get messier and messier as more persons are

added to the groups.)

(3) As noted in the introduction, the model has important implications for the attitude-behavior area. In particular, the choice model derived by Tversky implies a fundamentally different behavioral decision process from that proposed by Fishbein. Rather than comparing the various behavioral alternatives on the basis of holistic evaluations, the model (and the evidence cited in support of it) suggests that people look at various attributes of the behavioral alternatives in a sequential elimination process. This implies ^a ~~that~~ need for a different conceptualization of how an individual's attitude toward an act develops from Fishbein's attitude model (1963). In this view attitude toward an act would no longer be a relatively stable cognitive entity depending upon a subject's beliefs about the act and his or her evaluation of those beliefs. Instead attitude toward an act would vary as the set of relevant alternatives varied, because evaluation of an act would depend upon the attributes used to compare it to the other available alternatives. For example, breaking a leg might seem like a very desirable choice when compared with being thrown off a building or given a cement overcoat, but it might seem very undesirable when compared with getting a good night's sleep or reading a book. The difference in the two evaluations of the act "breaking a leg" is a function of the fact that different attributes of breaking legs are considered by the individual in forming his or her judgment in the two cases.

This model replaces Fishbein's formulation, where attitude and normative belief are independent predictors of behavioral intention, with a formulation that specifies how social situations influence individual valuations and probability beliefs concerning a behavioral alternative. In the present model, then, attitudes and normative pressures are interdependent and attitudinal and cognitive factors mediate the effect of social influence on choice. The author would contend that the present model is a significant improvement on Fishbein's model because it specifies a mechanism by which attitudes are formed and influenced, while Fishbein takes perceptions of social pressure and attitude-toward-the-act as givens.

(4) The validity of the model remains to be established. While a good deal of evidence was reviewed that supports the model, a test of the efficacy of the model as a whole is needed. A proposed experimental design has been developed and is available from the author. What should be the nature of research on the model? Aside from the mathematical hypotheses developed in the body of the paper, the author sees two main areas of concern. First, it would be best if values and probabilities attached to attributes could be measured indirectly or without keying the subjects to the idea that changes in these variables were being measured. An experiment designed to test a model such as the one developed above is extremely sensitive to experimenter-induced effects. If subjects discovered the hypotheses and for one reason or another were induced to respond to the group discussion in a way consonant with the hypotheses, the goodness-of-fit test of the model could be severely biased. An experiment performed by Anderson and Graesser (1976) to test a model similar to the message effects models developed above is open to indictment on these grounds. In their design, subjects are asked their attitudes on Presidents between discussion periods. It is difficult to believe that subjects didn't realize the point of the study, and their well-meaning cooperativeness may have resulted in a greater degree of fit than the model warranted. Second, the model developed above may only be valid for subjects where people are not highly committed or ego-involved. Research on social judgment theory has indicated that with topics where there is a great degree of subject involvement, the discrepancy model of attitude change (on which the group influence model is based) does not hold (Freedman, 1964; Whittaker, 1967). Thus, considering several levels of involvement with subject matter might be necessary to adequately ascertain the scope of the model.

*Add section (5) on usefulness
of hooking machines together.*

FOOTNOTES

¹Schuman and Johnson present several other possible explanations for this correlation on p. 186. In view of the evidence accumulated concerning social conformity the hypothesis incorporated into the model developed here seems the most reasonable.

²If we desire to take each message an individual sends in a time period into account, we can do so by the more complex expression

$$M(\alpha_i) = \frac{\sum_{j=1}^n \sum_{k=1}^{l_j} v_j m_{jk}(\alpha_i)}{\sum_{j=1}^n v_j l_j}$$

where $m_{jk}(\alpha_i)$ is the k th message sent by the j th person and l_j is the number of messages sent by the j th person. Other notation is as before.

³It would also be possible to build a model that incorporated the effects of each individual message into a subject's attitude. However, unless we make some fairly restrictive assumptions about the messages the subject receives, these models become very unwieldy. Hunter and Cohen (1974) have developed a number of models of attitude change based on this principle.

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Vinokur, A. (1971) Cognitive and affective processes influencing risk-taking in groups: an expected utility approach. JPSP, 20, 472-486.

We start with the system,

$$x_2 = \omega y_1 + (1-\omega)x_1,$$

$$y_2 = \omega x_1 + (1-\omega)y_1,$$

Or, if we let $(1-\omega) = \delta$

$$x_2 = \omega y_1 + \delta x_1,$$

$$y_2 = \omega x_1 + \delta y_1,$$

First we will solve for x . The first step is to generate a second order equation for x .

$$x_3 = \omega y_2 + \delta x_2$$

$$x_3 = \omega(\omega x_1 + \delta y_1) + \delta x_2, \quad \text{since } y_2 = \omega x_1 + \delta y_1,$$

$$x_3 = \omega\left(\omega x_1 + \delta\left(\frac{x_2 - \delta x_1}{\omega}\right)\right) + \delta x_2, \quad \text{since } y_1 = \frac{x_2 - \delta x_1}{\omega}$$

$$x_3 = \omega^2 x_1 + \delta x_2 - \delta^2 x_1 + \delta x_2$$

$$= (\omega^2 - \delta^2)x_1 + 2\delta x_2$$

$$= \gamma x_1 + 2\delta x_2$$

$$\text{, letting } \gamma = \omega^2 - \delta^2$$

Now, can we find a solution for the second-order equation?

$$0 = x_3 - 2\delta x_2 - \gamma x_1$$

If we assume there is a solution of the form $x_n = \lambda^n$, then

$$0 = \lambda^{n+2} - 2\delta \lambda^{n+1} - \gamma \lambda^n$$

$$0 = \lambda^n (\lambda^2 - 2\delta \lambda - \gamma).$$

Thus either $\lambda^n = 0$ or $\lambda^2 - 2\delta \lambda - \gamma = 0$.

The first solution, $x_n = 0$ for all n , is trivial. To solve the second equation we can use the quadratic formula, thus:

$$\lambda = \frac{2\delta \pm \sqrt{4\delta^2 + 4}}{2} = \delta \pm \sqrt{\delta^2 + 1}$$

So $\lambda_1 = \delta + \sqrt{\delta^2 + 1}$ and $\lambda_2 = \delta - \sqrt{\delta^2 + 1}$ and

$x_n = (\delta + \sqrt{\delta^2 + 1})^n$ and $x_n = (\delta - \sqrt{\delta^2 + 1})^n$ are two solutions of the system outlined above.

The next task is to obtain an expression for x_n in terms of the input values x_0 and x_1 . It can be shown that

$$x_n = C_1 \lambda_1^n + C_2 \lambda_2^n$$

is a general solution for the second order equation if C_1 and C_2 are constants. Given specific values of x_0 and x_1 , we can find values of C_1 and C_2 that will allow us to predict the resulting sequence as follows:

$$\begin{aligned} \text{Given } C_1 \lambda_1^0 + C_2 \lambda_2^0 &= x_0 \text{ and} \\ C_1 \lambda_1^1 + C_2 \lambda_2^1 &= x_1, \end{aligned}$$

we can solve for C_1 and C_2 , obtaining the following expressions:

$$C_1 = \frac{x_1 - \lambda_2 x_0}{\lambda_1 - \lambda_2}$$

$$C_2 = \frac{x_1 - \lambda_1 x_0}{\lambda_2 - \lambda_1}$$

So the final general solution is:

$$x_n = \left(\frac{x_1 - \lambda_2 x_0}{\lambda_1 - \lambda_2} \right) \lambda_1^n + \left(\frac{x_1 - \lambda_1 x_0}{\lambda_2 - \lambda_1} \right) \lambda_2^n$$

where $\lambda_1 = \delta + \sqrt{\delta^2 + 1}$ and $\lambda_2 = \delta - \sqrt{\delta^2 + 1}$.

Since $\delta = 1-w$ and $\gamma = \omega^2 - \delta^2 = \omega^2 - (1-w)^2 = 2w-1$
we get,

$$\lambda_1 = 1-w+\sqrt{\omega^2} = 1 \quad \text{and} \quad \lambda_2 = 1-w-\sqrt{\omega^2} = 1-2w$$

Thus
$$x_n = \frac{x_1-x_0}{2w} - \frac{x_1-x_0}{2w} (1-2w)^n$$

is an exact solution in terms of the original parameters.

Since $0 \leq w \leq 1$ we have two possible limits:

(a) If $0 \leq w \leq \frac{1}{2}$, the limit x_n^* is:

$$x_n^* = \frac{x_1-x_0}{2w}$$

as the value of x_n very slowly increases to the ceiling x_n^*

(b) If $\frac{1}{2} < w \leq 1$, the limit x_n^* is:

$$x_n^* = \frac{x_1-x_0}{2w}$$

but it gets there by oscillating about x_n^* .

The equilibrium value is therefore $x_n^* = \left| \frac{x_1-x_0}{2w} \right|$, since all values of x_n must be positive.

+

In the same manner, the second-order equations for y could be solved to yield

$$y_n = \frac{y_1-y_0}{2w} - \frac{y_1-y_0}{2w} (1-2w)^n$$

and

$$y_n^* = \left| \frac{y_1 - y_0}{2w} \right|.$$